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ABSTRACT

To maintain credibility, vocational teachers must be exposed to advanced technology in ways consistent with its use in their occupational specialty area, as well as contemporary techniques for using it in the delivery of instruction. The technical and teaching skills and knowledge of Indiana's vocational teachers must be continually upgraded. Change must be presented in the following contexts: the changing workplace, changes in education, the changing learner, changes in teacher responsibilities, and professional development concerns. A series of competency-based modules have been developed for vocational education teachers. They cover the general competencies teachers must learn to function effectively. Kansas, Alabama, and Michigan have developed statewide systems for professional development of teachers in the area of technology education. Some businesses and industries have also undertaken initiatives to further an understanding of advancements in occupational technologies and the use of technology in the classroom. They include Tandy Corporation/Radio Shack, Cummins Engine Company, Otis Elevator, Westinghouse, and Rogers Building Group. Mentorships have also been used as an innovative way of updating teachers' knowledge of their field of study. Individual teachers have also recognized specific needs and initiated their own programs. (27 references) (YLB)

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Technology and the Changing Faces of Vocational Education

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A VES Briefing Paper

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TECHNOLOGY AND THE CHANGING FACES

OF VOCATIONAL EDUCATION

Indiana, like the rest of the nation, is facing a changing work environment which is having a direct impact on its education system. Technolgy has drastically changed job tasks of individuals in manufacturing, agriculture, health care, and information services, to name a few.

> While new forms of technology will fuel the technological revolution in every aspect of modern life, people will determine whether the revolution catches on and is implemented through schools.
>
> Dramatic deviations from the traditional are required if teachers are to adjust to the rapidly changing community. There cannot be "innovative" changes in educational programs that do not involve teachers and in-service opportunities. The most fundamental changes that must occur in schools must first occur with teachers.
>
> High-quality professional personnel at all levels are essential to vocational education programs. Professional education personnel are unique in that they must possess occupational experience in addition to meeting requirements for teacher certification. If vocational teachers are to assist in training others for the changing world of employment, it then is essential that those same teachers must have opportunities to upgrade their skills and knowledge.[1]

It is important to note that changes in technology affect vocational teaching professionals in two major ways. First, rapid advances in occupationally specific technologies require that teachers be provided the means to stay current to better prepare their students for today's workplace. Second, many advanced technologies are entering the classroom as tools for

instructional enhancement and teachers need assistance in adapting to these changes. In both instances, teachers who keep current with technology advances are reinforcing the message to the students they teach that technology and its applications are important in an ever changing world of work, whether it be the private sector workplace or the work domain of the teacher, the classroom and lab.

In order to maintain credibility, it is important that the vocational teacher be exposed to advanced technology in ways that are consistant with its use in their occupational speciality area, as well as contemporary techniques for using it in the delivery of instruction. In order to achieve these goals, means must be found to continually upgrade the technical as well as teaching skills and knowledge of Indiana's vocational teachers. In so doing, change must be presented in the following contexts:

The Changing Workplace. Vocational educators have historically prepared students for the workplace by teaching occupationally specific skills. This was particularly true during the Agricultural and Industrial Eras. While agriculture and industry are still important parts of our lives, services and information have become the dominant products of today's workplace. Technology has become an added mechanism for quality and efficient production. The types of skills that need to be incorporated into today's vocational classroom in order to

enhance the occupational skills being taught include: decision-making, problem-solving, team collaboration, individual job responsibility, as well as, a basic understanding of technology and its' capabilities.

Changes in Education. Technology has become an integral part of the classroom. Teachers are expected to keep abreast of current instructional technology and then, incorporate it into the classroom, often with limited resources. Additionally, they are asked to respond to the needs of special populations, consider new curricula, write new curricula, spend more time dealing with parental concerns, and public advisory groups. Teachers are being asked to respond to the total needs of learners within the school environment, even though many of these needs have been generated by societal pressures which are beyond the bounds of the school. While these activities are necessary to prepare today's learners for today's workplace, teachers are absorbing much of the responsibility with minimal training.

The Changing Learner. Children today are faced with multitudes of choices, and have had wide ranging experiences that directly affect their behavior in the classroom. Emotional upheaval over a divorce, peer pressures that conflict with home values, and substance abuse in the home and at school, are but a few of the pressures that have a negative impact on the child's ability to concentrate and learn. In numbers never experienced before,

schools are facing the special needs of latch-key children, teen-parents, and slow learners. Mandates for equal access for special populations have expanded these populations within the schools. In short, teachers are having to learn to adjust and cope with the changing characteristic of today's learners.

Changes in Teacher Responsibilities. Vocational teachers are being asked to address a whole host of issues. These include, but are not limited to, basic skill development, occupational skill development, employability skills, and special learning styles. They are being asked to develop curriculum, supervise job experiences, assess the learner before, during, and after leaving training, and work more closely with the community, advisory boards, and parents. While these responsibilities are being attended to, technology continues to advance at a rapid pace.

Professional Development Concerns. In considering professional development activities to assist teachers in adjusting to and coping with change, attention must be focused on the teacher as a learner. Vocational education teachers come from various educational backgrounds. Some have bachelors degrees in their field, some have bachelors degrees in a related field of study with on-the-job experience in the occupation they are teaching, while others have years of experience in a trade or business/industry settings without a formal degree.

Because of this broad spectrum of acceptable qualifying credentials for entry into vocational education teaching, professional development activities, criteria, and requirements become complex. If professional development activities are to address change in the workplace, education, technology, and the learner, and, adapt to the wide variance in the backgrounds of the vocational teacher population, a wide range of activities must be developed. The activities should be consistent in their training requirements and expectations and be monitored in a fair and equitable manner. This can be accomplished through standardization of teacher competencies.

PROFESSIONAL COMPETENCIES: A PARTIAL ANSWER

Lois Harrington, Instructional Design Specialist, at the Center on Education and Training for Employment (previously the Center for Research in Vocational Education) in Columbus, Ohio, described the competency-based modules that have been developed for vocational education teachers (secondary and postsecondary level). The modules are the result of a two-year study involving teacher educators from each of the vocational disciplines. They were reviewed by educators in the field, and then revised and field tested in 10 to 15 different sites. They were originally published in 1978 and revised in 1981-82.

The most frequently used of the 132 modules are titled: Instructional Planning, Instructional Execution, and Instructional Evaluation. Major categories include: Program Planning, Development, and Evaluation, Instructional Management, Guidance, School/Community Relations, Professional Roles and Development, and Cooperative Education. Over the last few years, Center staff have recognized gaps that need to be addressed in areas such as special needs populations, establishing a co-op program, helping students to improve basic skills, and adults in vocational education.

A module is divided into a series of learning experiences. Teachers wishing to complete a module (i.e., competency) must have a resource person, master teacher, or a supervisor work with them. Once a teacher has studied the material, an opportunity to practice must be provided. The final experience is to perform the competency in an actual class. The master teacher is an integral part of the training process, providing guidance throughout the process. The Teacher Performance Assessment Form (TPAF) is filled out by the master teacher to verify completion and success of the modular program. The report is then submitted to the teacher's school system for placement in the teacher's personal file.

School systems can use the system for professional development credits, promotional incentives, and merit raises. The National Association of Trade and Technical Schools (NATTS) uses the modules for their staff development program. For their purposes, the modules were organized into levels. Certificates were presented to staff sucessfully completing each level.

The modules cover the general competencies that teachers must learn in order to function effectively as an instructor and program planner. By incorporating an individual assessment, checklist, or approrpriate evaluation of these competencies for each teacher, a vocational program, school, or system can document the basic skill levels of its staff and monitor staff development activities.[2]

Specific, occupational skills must be learned through contact with an occupational environment. The remainder of this paper will introduce initiatives undertaken by states, businesses, research institutions, and individual teachers to further an understanding of advancements in occupational technologies and the use of technology in the classroom.

STATE INITIATIVES

Specialists in six states were contacted during the process of preparing this paper. Three states have developed a state-wide system for professional development of teachers in the area of technology education. The programs vary in scope and intensity. Some programs are not specific to vocational education, but appear to be initiatives that could easily be transferred to vocational education systems.

Kansas

According to Tom Moore, Director of Vocational Education Administration, the Kansas Department of Education has established state guidelines for a Principles of Technology Program. The requirements were authorized by Article 6, Section 2(a) of the Kansas Constitution, effective March 13, 1989. These requirements establish criteria for a professional development endorsement to teach Principles of Technology.

The actual guidelines state that:

> Each applicant (teacher) for an endorsement in principles of technology shall have completed a state-approved program in principles of technology and shall be recommended by a teacher education institution. An approved program in principles of technology may follow one of two patterns. It may consist of three workshops, with prerequisite competencies established to be eligible for admission to the program, or the program may be a comprehensive program with all competencies contained in the program.[3]

> Approved comprehensive programs shall require students to complete a course of study allowing the students to demonstrate competencies in 9 areas such as: problem-solving techniques, concepts of algebra and physics and technology of power.[4]
>
> Approved programs of three workshops shall require, as prerequisites to admission, that the students demonstrate knowledge of:
>
> * the fundamental concepts of algebra;
> * fundamental concepts of physics; and
> * knowledge of the technology of power, including its sources, generation, and transmission, and the use of powered devices and vehicles.[5]
>
> Approved programs in the three-workshop pattern shall require students to complete the remaining 6 competencies noted in the comprehensive course of study.[6]

According to these guidelines, provisional endorsement is given to applicants in the three-workshop pattern-approved program.

> An applicant shall be issued a provisional endorsement, valid for one year upon receiving the recommendation of a teacher education institution and having completed the initial workshop. Provisional endorsement may be renewed for an additional year upon receiving the recommendation of a teacher education institution and completing the second workshop.[7]

Alabama: A Plan for Excellence

Steve Franks, Vocational Education Director for the State of Alabama, was enthusiastic about Alabama's Plan for Excellence. The Plan, focused exclusively on secondary vocational programs outlines the comprehensive approach used by Alabama to gather information, make recommendations to policy-makers, and establish

a plan of action. In the section titled Recommendations for Quality Teaching, three final recommendations were suggested to improve the quality of teaching provided to vocational completers.

1. Strengthen Academic Preparation and Technical Update of Vocational Teachers and Applied Teaching Methods of Academic Teachers.

To facilitate the achievement of this recommendation, the State Board of Education should support the following:

* First, the local school systems should conduct an individual assessment of current vocational teachers and develop for each an individual professional development plan for areas of assessed need.

  The State Department of Education, through a task force of teachers, teacher educators and local administrators, would develop approaches and procedures for local school systems to follow in conducting the needs assessment. Current vocational staff should be required to complete, within three years, a program of professional development according to need identified in the individual needs.

* Second, local school systems should require math, science and English teachers who teach students taking a concentration in vocational education to complete in-service activities on improving academic instruction for vocational students.

* Third, the State Superintendent of Education would assign appropriate staff to work with colleges, the Center for Vocational and Adult Education at Auburn University and local school systems to develop a series of staff development courses and workshops designed to address the needs of vocational teachers in terms of basic competencies, teaching methods for reinforcing basic competencies, methods for coordinating vocational and academic instruction, and revising vocational curriculum to give direct and purposeful attention to increasing student achievement on basic competencies.

  The appropriate state staff should also work to provide in-service programs to assist academic teachers who teach vocational students with methods on teaching basic and academic skills and concepts through applied

instruction, and on academic and vocational instruction coordination for students with deficiencies in reading and math.

* Fourth, all vocational teachers should be required to complete 60 clock hours or six semester hours of technical update every five years as a basis for maintaining their certificate. The technical update should become a part of the needs assessment and professional development plan for each teacher and should be required by the local school system.

* Fifth, the State Department of Education should identify teacher centers throughout the state, utilizing existing teacher education institutions, technical colleges, area vocational centers and employers. Such centers could be used for technical updating, student organization activities, leadership development, curriculum development and other appropriate functions. Periodic in-service meetings should be planned to address current needs, utilizing business and industry representatives as resource people.[8]

2. Revise Certification Requirements and Preparation Programs for Vocational Teachers[9]

The issue of certification is not only crucial for updating technological expertise of teachers who have been out of the mainstream of advancements in their fields, but it also has the capacity to improve the non-degree teachers background in basic, academic and technical knowledge and skill areas. While speaking to the issue of technology, Alabama has incorporated into their Plan for Excellence revised certification requirements for non-degree vocational teachers. In order to make the fullest contribution to the educational advancement of the youth of the state, these teachers need to add their valuable practical experience an appropriate degree program, thereby showing evidence of improved basic, academic and technical knowledge and skills. The State Board of Education should establish as a long-term goal the staffing of secondary vocational programs with teachers who have completed a preparatory program that gives adequate attention to a sound general, technical and professional education foundation.[10]

3. The Plan of Excellence recommends specific certification requirements for current and new non-degree vocational teachers. Provisional certificaion would be given until

requirements were completed. In addition, certification levels would reflect salary ranges.

To determine other changes needed in approved teacher education programs and certification, the State Superintendent should establish a task force on vocational teacher education and certification. The task force should examine pre-service and in-service programs and make recommendations for change based on improvements, changes in educational standards, and changes in technology.[11]

Michigan

William R. Rude, Coordinator for the Planning, Evaluation and Finance Unit of the Michigan Department of Education, wrote in a letter dated March 29, 1989, that "as VTE (Vocational and Technical Education) is promoted, the "hi-tech" needs and occupations also become more visible promoting the concept for teachers that they need not only keep up, but get-ahead of the technology race. Building new technologies into the curricula of VTE is obviously more difficult. Michigan does not have a State mandated curriculum. Rather curriculum change is promoted through the development of curriculum guides. Workshops for teachers and administrators help train the teachers and promote their use."[12]

BUSINESS/INDUSTRY AND TEACHERS

The following descriptions of professional development activities specify ways teachers can update their technical skills.

Tandy Corporation/Radio Shack

This particular program initiative documents how a business has invested in education, utilizing its business expertise in technology to reach teachers and students in their own environment with a program that is designed for their own situation.

> Tandy Corporation/Radio Shack recognized the importance of computers in the instructional setting and in 1981 instituted a program to offer training in computer literacy to teachers at all levels from elementary to universities. The program was so successful that by the fall of 1983 more than 400,000 teachers had completed the training.
>
> Tandy continues to support related teacher staff development and during 1987-88 school year worked with four of its instructional software publishing partners to present a series of elementary curriculum software seminars in ten cities. We recognize staff development to be one of the critical issues facing education today. Our current approach is to enter into selected partnerships and custom design an in-service program to meet specific needs.
>
> In order for technology to find its place in the school environment, more effort must be devoted to experimentation and dissemination. Business and industry should and must work together with education and construct viable implementation models.[13]

In a description of the Projects, Radio Shack stated that:

> During the 1988-89 school year, they will support a number

> of selected technology related staff development efforts to train Master Teacher Trainers who will focus on the issues of curriculum integration. This will be accomplished through a cooperative work plan developed jointly with selected state departments of education and/or major school districts, selected instructional software publishing partners and Radio Shack. It is expected that the model/ models developed from these efforts on the computer as an instructional tool will bring with it a fully integrated teacher support system.[14]

The implementation of this project follows five major steps. Within each of these steps, a purpose, process and product is established. The five main steps are: (1) identify participants and define scope of project, (2) plan the project, (3) plan for the Master Teacher Trainer outcomes, (4) implement program with selected Master Teacher Trainers, and (5) develop final project report.

> The planned outcomes must recognize the skill and time required in order to effectively apply technology within the teacher in-service training program as integral instruction rather than as a separate area of instruction.
>
> The Master Teacher Trainers will identify ideal technology-related activities and will explore and experiment with the products of technology in new and innovative ways in an instructional setting. Also, there is increased understanding of what is an appropriate or inappropriate use, as it relates to the issues of curriculum integration and support for technology using teachers.[15]

Advantages of this program include:

- teachers being trained with up-to-date technological equipment,
- teachers being trained to train others within their system, thus decreasing overall system staff training costs,
- teachers using technology to develop programs specific to their situation, and

- planning involves joint decision-making with representatives from administration and teaching staff.

Costs for this kind of program are negotiated with the Radio Shack representative once an interest has been expressed.

Cummins Engine Company

Mary Ann McCray, Director of Community Relations at Cummins Engine Company, reported that Cummins has an interest in working with teachers in the community. Just this summer, they were involved with a program funded by the Indiana Department of Education, through the Columbus Chamber of Commerce, which placed over 30 teachers in Columbus area businesses. Cummins had 6 teachers working with Cummins employees, one of which was in the field of electronics. The program was not limited to vocational education teachers, and included internships with management staff, research, and counseling. Grant monies were used to pay teachers a stipend. It is hoped that informal communications will continue over the school year making the program more long-term than the grant timelines.

McCray made note that Cummins' informal connections with educational groups, such as Advisory Boards with Indiana Vocational Technical College (Ivy Tech) and Area Vocational Schools, were good ways of staying in touch with the vocational

education needs in the community, as well as, relaying the employer needs to educators. These groups, working closely with employers on an ongoing basis, provide opportunities for teachers to understand the changes occurring in the workplace and to incorporate the knowledge into the classroom experience.[16]

Patty Shutt, Planning Specialists for Vocational Education with the Indiana Department of Education, expanded on the Internship Program. The Department of Education's intent, in funding four pilot summer programs, was to provide opportunities to update teachers in technological developments, equipment changes and any procedural changes that have occurred in their particular field of study. After the summer internship, teachers will prepare curriculum plans to be used in the classroom.

While the grant monies were funnelled through the Department of Education, three separate financial resoures were combined for this special pilot project: the Corporation for Science and Technology, the Indiana Commission on Vocational and Technical Eduation (ICVTE), and the Indiana Department of Education's Carl D. Perkins money. The monies were used to pay teachers a stipend.[17]

Otis Elevator, Westinghouse, & Rogers Building Group

Bruce Ricklin, Tech Prep Project Manager of Hoosier Hills Area

Vocational School, provided more detail on an independent internship project (noted by Shutt) with industry in Bloomington, Indiana. As a result of contacts with industry through piloting the Tech Prep Program (an ICVTE-funded program), the Area Vocational School staff and local businesses developed a framework for internships for teachers. The initial endeavor was developed for 40 hours a week for 8 weeks. An adjusted final timeframe for this first summer was 50 hours with a $500 stipend. Only teachers in the following areas were able to participate: science, business, vocational education (not including home economics), language arts, and mathematics.

The businesses, Otis Elevator (United Technologies), Westinghouse, and Rogers Building Group, all contributed financially to pay for internship stipends. It is hoped that with more time to plan, teachers and employers alike will be encouraged by and want to participate in the internship experiences. While teachers receive up-to-date knowledge and experience in technologies and the workplace, business and industry are able to assist in training their own future workforce, as well as, receive State tax credit for hiring teachers in shortage areas.

Ricklin is encouraged by the involvement of business/industry and the gradual development that is occurring. By taking time to organize specific internship experiences, individual needs are

being met as well as quality programs and connections being established. Ricklin also stated that in his discussion with area industry personnel, General Electric staff noted that, in Atlanta, experiences like these were being incorporated into college credits for Occupational Studies Programs.[18]

APEX Technical School

Milton Miller, Director of Education, APEX Technical School, New York, New York, offered some insight on how business/industry and educators can work together to keep abreast of the changes in products, equipment, and/or techniques. For instance, Sherwin Williams Paint Company offers free demonstrations/training to local businesses to enhance the sale of its products. Welding companies have also used this technique to generate sales of new equipment. When industrial settings are not available for these demonstrations, vocational education teachers may be able to provide the classroom space. If companies are charging for training consultants, perhaps business and education can share the cost.

Sharing of resources can be mutually beneficial, as can having business represenatives and vocational educators learning the most current changes in their field of work/study. The more vocational education teachers can be exposed to the world-of-

work, i.e., the changes in operations, technology, and products, the better able they will be to prepare students for employment. Businesses will benefit by having: (a) employees who have a realistic understanding of their job tasks, and (b) a direct line of communication with teachers who may be able to assist them if employees are not prepared or need additional training in specific job functions.

In talking about these possibilities, Miller emphasized that these kinds of cooperative ventures could be ongoing if linkages were made with key personnel in each area, whether business or education. In considering building these linkages, key personnel to approach include: technical consultants, field representatives, training specialists, community relations representatives, area vocational school teachers, and postsecondary vocational education instructors.[19]

Mentorships with Researchers

According to an article in the February 1989 issue of "Phi Delta Kappan," mentorships were used as an innovative way of updating teachers knowledge of their academic field of study. While the subject areas were science and mathematics education, the concept may well be transferable to vocational and technical education. Two specific mentorships discussed were as follows.

Baylor College of Medicine, Rice University, Texas Southern University, The University of Houston, and the Houston Museum of Natural Science. The article states that over the last four years, 120 secondary teachers from 15 school districts were matched with mathematics and science professionals. These professionals were associated with Baylor College of Medicine, Rice University, Texas Southern University, The University of Houston, and the Houston Museum of Natural Science. Teachers and mentors receive stipends for their efforts. It is a year-long program with the major study taking place during a six-week summer session. Each teacher/mentor team establishes its own plans and develops programs to meet individual needs.

Results of these individual programs include: a chemistry teacher developing an instructional unit to introduce students to recombinant DNA; a life science teacher developing a lab manual for middle school students to follow while learning to use the physiograph (a very sophisticated medical instrument), a math teacher developing a curriculum to teach probability and statistics; and an advanced math survey that involves set theory, logic, mathematical systems and finance.

These programs are implemented the following school year after the summer session with the researchers. Mentors are available throughout the year and often arrange for sharing equipment

and tours of research facilities to enhance the learning experience within the secondary classroom.

The advantages of this type of program are numerous and varied:

* researchers and postsecondary professionals learn firsthand what is going on in public schools,
* research and postsecondary professionals may incorporate and/or change the emphasis placed on teacher preparation activities,
* researchers and postsecondary professionals learn respect for the secondary professional,
* the curriculum developed can be disseminated throughout the school districts resulting in updated and enriched curriculum,
* increased interaction among teachers as the teachers train other teachers to use the curriculum,
* teachers involved in the program gain a renewed confidence and respect for themselves as a professional,
* teachers expand beyond the original project and continue to develop materials using the same networks established in the initial program,
* public school teachers have earned the respect of researchers and university professionals, and
* through this mechanism, the small monetary investment goes a long way and reaches many more professionals and students than the original teacher/mentor team.[20]

Rutgers University. One other university, Rutgers, also initiated contact with secondary school systems by working with teachers to develop curricula using current scientific information. In this collaborative process, the scientists

framed the scientific issues and the teachers organized and sequenced the materials and judged the appropriateness of various instructional approaches.[21]

The program at Rutgers, titled the University/Industry Programs for Education in the Sciences, has been developing since 1983. The industries involved have included Merck & Company (a pharmaceutical firm), AT&T Bell Laboratories and Bell Communications Research. The modules these teams (high school teachers and research scientists) develop are flexible in format. Once the modules are tested, they are used in dissemination and training programs aimed at improving the backgrounds of larger groups of science teachers.[22]

The cost of the initial development of the modules was supported by private industry and from the New Jersey Department of Education. To date more than 150 teachers and more than 2,000 students have been exposed to the materials.[23]

Coupled with the advantages listed earlier, a more subtle advantage is how the teacher may begin to view technology or scientific information.

> As teachers begin to develop activities and write materials based on their experiences in the research laboratories, their own understanding of the subject matter is enhanced. They are more likely to view research findings as ideas to

be explored with students, rather than as items to be covered in a text.[24]

This advantage, in itself, could significantly change the teacher's whole approach to future professional development.

Individual Instructor Initiatives

While the above mentioned programs resulted in new curricula being developed, each was a system-wide approach or a broad program approach. The following programs were initiated on a smaller scale as a result of a teacher or teachers recognizing specific needs within their own classroom or school.

One such program was developed as a result of a decline in class enrollments, yet an increase in the number of skilled workers needed in high tech occupations in the area. Paul Duquette, a machine shop instructor at Nashua High School in Nashua, New Hampshire, decided to create a new course that would entice students and teach them valuable skills in the uses of technology. By working with other departments within the same school, instructors combined resources that could be used by pre-engineering students, drafting students and industrial technology and vocational machine shop students. The funding combined resources from a small State Industrial Technology grant and local funding.[25] In this case, it was the use of technology that

increased the interest of students in their education and their future.

Other examples of individual instructors that have developed innovative programs include:

* In Kansas, DeSoto Junior High School instructors are transforming their industrial arts program into "Explorations in Technology," patterning the curriculum after their state's model for technology education (discussed earlier in this paper). As a result of this change in curriculum, the roles of teacher and student have changed. Teachers become facilitators and students learn to collaborate and learn from each other. These types of experiences more realistically reflect learning in the workplace. The state as a whole also has successfully piloted a comprehensive program involving professional development of teachers in technology and innovative programs for middle schoolers.

* In Norfolk, Virginia, a Vocational Technical Center received funding from a NASA grant to conduct research and design for upcoming space shuttle flights. The students formed project teams patterned after the

organization of NASA employees. Students must come up with their own ideas, test them, publish the findings, and present them to NASA. NASA employees functioned as mentors.

Ron Fortunato, a teacher at Norfolk Vocational Technical Center, stated that since the students are conducting real-world research, they need the same tools used by their counterparts in research and industry. Apple computers were used to perform the same functions as the NASA counterparts: i.e., creating spreadsheets and databases, designing products, and doing technical illustration.[26]

* In Pittsburgh, Pa., computers are helping to reverse a decline in enrollments in office practice classes. The school outfitted an "Office of the Future" with all up-to-date equipment. The responsibilities of the students changed to actually running a business - tracking sales, using electronic mail, etc..[27]

CONCLUSIONS

The changing workplace demands that technology be included in the professional development of vocational education teachers. While technolgy is the primary emphasis of the programs described above

broader educational outcomes were achieved. It is also important to note that the incentive, the cost, and the implementation of many of the training programs were cooperatively initiated and shared with business, research institutions, and government agencies. In several instances, programs were developed in response to legislation or the dissemination of grant monies.

Yes, there is a place for technology education for vocational education teachers. It not only benefits the teacher professionally, but has a direct and positive impact on student learning through new and innovative curriculum development and implementation. Ultimately, employers benefit by having employees that are trained environments which more accurately reflect what is happening in the "real world."

ENDNOTES

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2. Phone conversation with Lois Harrington, Instructional Design Specialist, the Center for Education and Training for Employment, Columbus, Ohio, June 13, 1989.

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8. Teague, Wayne. A Plan for Excellence: Alabama's Secondary Vocational Programs. The State Department of Education, August 13, 1987, p. 41,42.

9. Ibid, p. 42.

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11. Ibid, p. 42,43.

12. Rude, William R.. Personal Communication to Amy Sutley, March 29, 1989.

13. Radio Shack Education Marketing. A Proposal for a Series of Radio Shack Sponsored Master Teacher Trainer Programs. Fort Worth, Texas, p. 1.

14. Ibid, p. 2.

15. Ibid, p. 2,3.

16. A phone conversation with Mary Ann McCray, Director of Community Relations for Cummins Engine Company in Columbus, Indiana on July 24, 1989.

17. A phone conversation with Patty Shutt, Planning Specialist for Vocational Education, Indiana Department of Education on July 24, 1989.

18. A phone conversation with Bruce Ricklin, Tech Prep Project Manager, Hoosier Hills Area Vocational School, Bloomington Indiana on July 24, 1989.

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